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Variation in Age at First Marriage among Women in Nigeria: A Multilevel Logistic Analysis.

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Abstract

Early marriage is associated with early childbearing particularly in the developing countries which is also related to low status of women, increased fertility rate, and adverse health risks on the mother and child. Multilevel Logistic regression model was applied to data on 3063 women who are married or have lived or are living with sexual partner(s) who participated in the 2005 National AIDS/HIV Reproductive Health Survey in Nigeria. The intercept is estimated as 0.2376 which translates to an expected proportion of 0.56. 41.42% of the variance in age at first marriage is attributed to the state-level. Christian women were found to be 2.26 times more likely to marry at later age other than 17 years compared to their Muslim counterpart. Women in urban areas were 1.44 times more likely to marry early than rural dwellers. Women with Koranic education alone are 43.72% more likely to marry early; women with secondary and higher education are 3.44 and 4.8 times more likely to marry at ages above 17 years compared to women with primary education only. For state-level factors, women from the North-west and North-east zones are 77% and 62% respectively more likely to marry at age less than 18 years compared to women from the North-central. South-east and South-west women are 2.29 and 4.15 times less likely to marry prematurely when compared with women from the North-central.

Keywords: Multilevel models, logistic regression, hierarchical, odds, age at first marriage.

1. Introduction:

The age at marriage is of particular interest because it marks the transition to adulthood in many societies; the point at which certain options in education, employment, and participation in society are foreclosed; and the beginning of regular socially acceptable time for sexual activity and childbearing. “Marriage” carries very different meaning in different cultures and at different times. Marriage is linked to ceremonies, formal registration, change in social status, obligations and rights, social or legal acceptability of having sex and/or children, formation of a new house and so on. In most societies, marriage marks the point in a woman’s life when child bearing first becomes socially acceptable. Those who marry early will, on average, have longer exposure to pregnancy and a greater number of lifetime births. Thus, early marriage will influence the fertility rate of any nation or community leading to uncontrollable population growth. As such, marriage is not only the most predominant context for childbearing but also one of the most important determinants of fertility (Lesthaeghe et al., 1989). Various researchers believe that understanding variations in age at marriage helps in explaining differences in fertility across populations and fertility within individual populations over time (United Nations, 1990; Ezeh and Dodoo, 2001; Adeniyi et al, 2013).

Marriage according the Oxford Advanced Learner’s Dictionary (2000), is “the legal relationship between a husband and a wife”. Since marriage is a matter of choice, the age at which people get married would vary across groups and individuals. Several factors may account for this variation: socio-economic factors, religion, educational attainment, cultural beliefs about marriage, location, peer/ family pressure etc. These and several other reasons may influence peoples’ choice of when to get married.

For boys and girls, early marriage has profound physical, intellectual, psychological and emotional effect limiting educational opportunities and personal development. While early marriage takes different forms and has varying causes, one issue is paramount, that is, whether it happens to a boy or a girl, early marriage is a violation of human right (UNICEF, 2001). According to Inter-African Committee (I.A.C) on traditional practices affecting the health of women and children, “any marriage carried out below 18 years, before the girl is physically, physiologically and psychologically ready to shoulder responsibilities of marriage and child bearing is considered as early marriage” (UNICEF,2001). Early marriages will often result in family tension, increased divorce rate, increase in gender-based violence.

The multilevel regression model has become known in research Literature under a variety of names, such as 'random coefficient models' (de leeuw and kreft, 1986; Longford, 1993), 'variance component model' (Longford, 1987) and 'hierarchical linear model' (Raudenbush and Bryk, 1986, 2002). Statistically oriented publication tends to refer to the model as a mixed-effects or mixed model (Littell, et al, 1996). The multilevel regression model is a hierarchical system of regression equations with response variable measured at the lowest level, and explanatory variables at all existing levels.

Hierarchical linear models allow for the simultaneous investigation of the relationship within a given hierarchical level, as well as the relationship across levels. Two models are developed in order to achieve this: one that reflects the relationship within lower level units, and a second that models how the relationship within lower level units varies between units (thereby correcting for the violations of aggregating or disaggregating data; Hofmann, 1997). This modelling technique can be applied to any situation where there are lower-level units nested within higher-level units.

Assume we have data on J groups with N_j individual in each of the groups. On the individual level, we have the response variable Y_{ij} and P explanatory variables $X_1,\ldots,X_p$ and Q explanatory variables at the group level $Z_1,\ldots Z_q$. With only one predictor variable at the individual level, we have the separate regression equation in each group as

$$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + e_{ij} \tag{1}$$

The regression coefficient β carries a subscript j for the groups, which implies that the regression coefficients may vary across groups. The variation in the regression coefficients β_j is modelled by explanatory variables and random residual terms at the group level as

$$\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + u_{0j} \tag{2}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + u_{ij} \tag{3}$$

Substituting (2) and (3) in (1), we have

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{ij} + \gamma_{01} Z_j + \gamma_{11} Z_j X_{ij} + u_{ij} X_{ij} + u_{0j} + e_{ij} \tag{4}$$

Introducing the P explanatory variables at the individual level and the Q explanatory variables at group level, the model (4) becomes

$$Y_{ij} = \gamma_{00} + \sum_p \gamma_{p0} X_{pij} + \sum_q \gamma_{0q} Z_{qj} + \sum_q \sum_p \gamma_{pq} Z_{qj} X_{pij} + \sum_p u_{pj} X_{pij} + u_{0j} + e_{ij} \tag{5}$$

The γ are the usual regression coefficients while the u terms and the e are the residuals at the group and the individual level. The regression coefficients are the fixed part of the model because it does not change over the groups while the residual error terms are the random or stochastic part of the model.

$e_{ij} \sim N(0,\sigma^2)$ while the u_{0j} and u_{1j} are assumed to be independent of the individual level error term and to have a multivariate normal distributions with means of zero.

The proportion of the variance in the population explained by the grouping structure is estimated by the intra-class correlation ρ. The model with no explanatory variable at both levels (intercept only model) is used to estimate the ρ. The model is given as

$$Y_{ij} = \gamma_{00} + u_{0j} + e_{ij} \tag{6}$$

The intra-class correlation coefficient is estimated by the

$$\rho = \frac{{\sigma_{u0}}^2}{{\sigma_{u0}}^2 + {\sigma_e}^2} \tag{7}$$

Where σ_{u0}^{2} is the variance of the second level residuals and σ_{e}^{2} is the variance of the individual level residuals.

2. Multilevel Logistic Regression

When the response variable is dichotomous or a proportion, the assumption of continuous scores and normality are not met, also the homoscedastic assumption of errors is violated.

Consider a two-level model for binary outcomes with an explanatory variable at each of the two levels. This model is equivalent to model 1 except for the outcome variable. Let p_{ij} be the observed proportion of individuals in category I of group j. Although P_{ij} has a binomial distribution, logit (P_{ij}) has a distribution that is approximately Normal. The intercept-only model is given by

$$\log\left(\frac{P_{ij}=1}{P_{ij}=0}\right)=\beta_{0j} \tag{8}$$

The individual level error term e_{ij} is not in (8) because in binomial distribution, the variance of the observed proportion depends only on the population proportion; therefore, the individual level variance is determined by the predicted value for the P_{ij} and does not enter the model as a separate term (Joop and Cora, 2005).

Adding a predictor of the individual level, the model (8) becomes

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right)=\beta_{0j}+\beta_{1j}x_{ij} \tag{9}$$

The regression coefficient is assumed to vary across the group, which is modelled by the predictor of the group level.

$$\beta_{0j}=\gamma_{00}+\gamma_{01}Z_{j}+u_{0j} \tag{10}$$

$$\beta_{1j}=\gamma_{10}+\gamma_{11}Z_{j}+u_{ij} \tag{11}$$

Substituting (10) and (11) in (9), we have

$$\log\left(\frac{P_{ij}=1}{P_{ij}=0}\right)=\gamma_{00}+\gamma_{10}X_{ij}+\gamma_{01}Z_{j}+\gamma_{11}Z_{j}X_{ij}+u_{ij}X_{ij}+u_{0j} \tag{12}$$

The probability can be written as

$$\pi_{ij}=\frac{\exp\left(\gamma_{00}+\gamma_{01}z_{j}+\gamma_{10}x_{ij}+u_{0j}\right)}{1+\exp\left(\gamma_{00}+\gamma_{01}z_{j}+\gamma_{10}x_{ij}+u_{0j}\right)} \tag{13}$$

3. Intra-class Correlation

The intra-class Correlation ρ indicate the proportion of the variance explained by the grouping structure in the population. In the multilevel logit model, $\sigma_{e}^{2}=\pi^{2}/3$ by assumption, so that the intra-class correlation is

$$\rho=\frac{\sigma_{u0}^{2}}{\sigma_{u0}^{2}+\frac{\pi^{2}}{3}} \tag{7}$$

This is the intra-class correlation for the latent response variable.

4. Application to data on age at first marriage

The data used for this study were extracted from the 2005 National HIV/AIDS and Reproductive Health Survey (NARHS). NARHS is a nationally representative survey in Nigeria, which cut across the 36 states and the Federal capital territory. The question "How old were you when you first married or started living with sexual partner" was asked from the respondents during the survey and their ages at first marriage were recorded to the nearest years and this has been used as the response variable in this study.

The age at first marriage of individual woman *i* from state *j* is defined by a binary indicator

$$y_{ij} = \begin{cases} 1: & \mathrm{y_{ij}} \geq 18 \\ 0 & \mathrm{y_{ij}} < 18 \end{cases}$$

For this research work we shall consider the following three cases:

Case 1: Intercept Only Multilevel Logistic Model (Null Model)

We first fit a simple model with no predictors, that is, an intercept-only model that predicts the probability of marrying at an age not less than 18 years. The model is

$$\ln\left(\frac{y_{ij} \geq 18}{y_{ij} < 18}\right) = \beta_{0j} + u_{0j}$$

Case 2: Model with the individual-level factors

The model is

$$\log\left(\frac{pr(y_{ij} \geq 18)}{pr(y_{ij} < 18)}\right) = \beta_{0j} + \beta_1 urban + \beta_2 koranic + \beta_3 \sec ondary + \beta_4 higher + \beta_6 christianity + u_{0j}$$

Case 3: Model with inclusion of the state-level factors

The model is given as

$$\log\left(\frac{pr(y_{ij} \geq 18)}{pr(y_{ij} < 18)}\right) = \beta_{0j} + \beta_1 urban + \beta_2 koranic + \beta_3 \sec ondary + \beta_4 higher + \beta_5 christianity + \beta_6 north\_west + \beta_7 north\_east + \beta_8 south\_east + \beta_9 south\_west + \beta_{10} south\_south + u_{oj}$$

5. Analysis and Results

The multilevel process was stepwise. The first step examined the null model of overall probability of age at first marriage without adjustment for predictors. Second step included the inclusion of the factors at the individual level while the factor at the state level was added at the third stage of the analysis. The results of the fixed effects (measures of association) were shown as coefficients odds ratios (ORs) and their corresponding P-value.

Table 1 in appendix, presents the results for a sequence of three models: the intercept only model, a model with the individual level factors and a model with the state level factors.

For case 1 the intercept is estimated as 0.2376 which refer to the underlying distribution established by the logistic link function. To determine the expected proportion, the inverse transformation for the logistic link function is given by

$$g(x) = \frac{e^x}{1+e^x}$$

as is used. This gives an expected proportion of 0.56. The intra-state correlation coefficient implied by the estimated intercept component variance, 41.42% of the variance in age at first marriage is attributed to the state-level.

For case 2 the Christian women are 2.26 times more likely to marry at later age other than 17 years compare to their Muslim counterpart. Compared to women form residing in the rural locations, women living in the urban are 1.44 times more likely to marry at ripe age. Form educational qualifications, women with Koranic education alone are 43.72% more likely to marry prematurely while women with secondary and higher education attainment are 3.44 and 4.8 times more likely to marry at age above 17 years compared to women with primary education only.

Also for case 3 the inclusion of the state-level factors has effect on the contribution of individual-level factor as it reduces the odds of the factors at the individual-level. The Christian women are 1.85 times less likely to marry prematurely compare to Islamic women which is less than the odd estimated from model 2. Form the location of residence of the women, the odds estimated for this model is 1.41 as against 1.44 estimated from model 2; this has a slight reduction with when comparing women from the urban locations to the rural locations. Also, the odds of having Koranic education only reduces to 38.84% while the odds of marrying at age greater than 17 years is 3.38 and 4.79 times for women with secondary and higher education.

From the state-level factors, only south-south was not significant and so interpretation of the odd was not interpreted. Women form the North-west North-east zones are 77% and 62% respectively more likely to marry at age less than 18 years compared to women from the North-central. South-east and South-west women are 2.29 and 4.15 times less likely to marry prematurely when compared with women from the North-central.

6. Discussion

Using the multilevel logistic analysis, the study has shown that both individual and state level factors are important predictors of women's age at first marriage and demonstrate geographical variation in early marriage in Nigeria.

Nigeria is made up of six geo-political zones. This study reveals that Nigeria women's age at first marriage varies widely by zones. Specifically, beliefs that seem to encourage early marriage may be principal reasons for the observed geographical disparities. The study found that Islamic women had the tendency of marrying before the ripe age of 18 years than Christian women. Women from the Northern part of the country have the highest risk of marrying early than women from other zones of the country, with lower education attainment, women are prone to marrying early while women that marry too early are more in the rural areas than the urban areas.

7. Conclusion

The multilevel logistic analysis of age at first marriage found strong evidence that women's odds of getting married at early age was significantly associated with their location of residence, religion, and educational attainment**.** The study shows that geopolitical zones vary in rates of early marriage. Understanding the geopolitical zones differentials may aid in the identification of zones that may need to be particularly targeted with education and prevention programmes. Researchers trying to understand variation in individual risk of early marriage should pay attention to the characteristics of both individuals and the states of residence.

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Appendix

Table 1: Estimated Coefficients, the Odds Ratio for the Fixed and the Random Part of the Model

Model	**Intercept only**			**Model with individual level factor**			**Model with State level factor**		
	Coeff	Odd ratio	P-value	Coeff	Odd ratio	P-value	Coeff	Odd ratio	P-value
Fixed part									
Intercept	0.238	1.268	0.03	-0.566	0.568	0.006	0.654	0.148	0.001
Location									
Urban				0.365	1.440	0.002	0.343	1.409	0.003
Level of education									
Koranic				-0.575	0.563	0.003	-0.492	0.612	0.009
Secondary				1.236	3.443	<0.001	1.219	3.383	<0.001
Higher				1.568	4.800	<0.001	1.566	4.786	<0.001
Religion									
Christianity				0.816	2.261	<0.001	0.617	1.854	<0.001
Zone									
North-west							-1.471	0.230	<0.001
North-east							-0.971	0.379	0.002
South-east							0.830	2.294	<0.001
South-west							1.423	4.151	0.021
South-south							0.434	1.543*	0.197
Random part									
U_{0j} (se)	1.525 (0.187)			1.091 (1.44)			0.504 (0.801)		

Asterisk (*) indicates the variable that is not statistically significant

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